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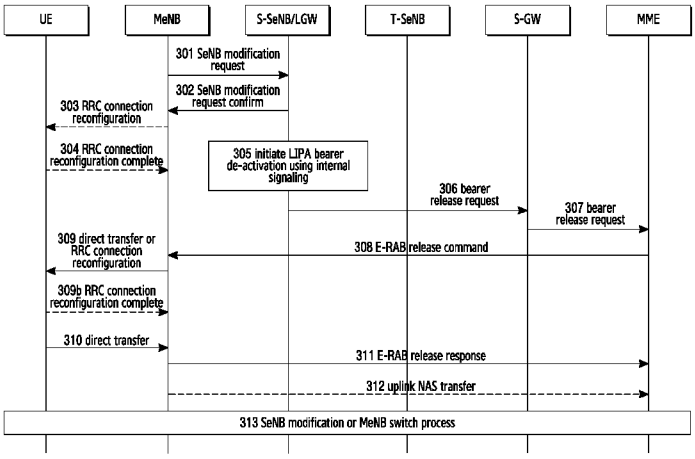
(54) **Title**: METHOD AND APPARATUS SUPPORTING LOCAL BREAKOUT IN A DUAL-CONNECTIVITY ARCHITECTURE



(57) **Abstract**: The present disclosure relates to a pre-5th-Generation (5G) or 5G communication system to be provided for supporting higher data rates Beyond 4th-Generation (4G) communication system such as Long Term Evolution (LTE). The present disclosure provides a method of de-activating a local IP access (LIPA) bearer supporting local breakout in a dual-connectivity architecture. When an MeNB determines to change an SeNB serving a UE or hand the UE over from the MeNB to an eNB, the MeNB may trigger a LIPA bearer de-activation process, and then trigger the process of change the SeNB serving the UE or hand the UE over from the MeNB to the eNB. Various examples also provide another method and an apparatus for de-activating a LIPA bearer, for bearer switch, for establishing a LIPA bearer. The methods and apparatus can establish, switch and correctly release local breakout bearer in a dual-connectivity architecture, so as to reduce the load of a core network of an operator.

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Description

Title of Invention: METHOD AND APPARATUS SUPPORTING LOCAL BREAKOUT IN A DUAL-CONNECTIVITY AR-CHITECTURE

Technical Field

[1] The present disclosure relates to wireless communications, and particularly, to a method and an apparatus for supporting local breakout in dual connectivity ar-chitecture.

Background Art

[2] To meet the demand for wireless data traffic having increased since deployment of 4 th generation (4G) communication systems, efforts have been made to develop an improved 5th generation (5G) or pre-5G communication system. Therefore, the 5G or pre-5G communication system is also called a 'Beyond 4G Network' or a 'Post LTE System'.

[3] The 5G communication system is considered to be implemented in higher frequency (mmWave) bands, e.g., 60GHz bands, so as to accomplish higher data rates. To decrease propagation loss of the radio waves and increase the transmission distance, the beamforming, massive multiple-input multiple-output (MIMO), Full Dimensional MIMO (FD-MIMO), array antenna, an analog beam forming, large scale antenna techniques are discussed in 5G communication systems.

[4] In addition, in 5G communication systems, development for system network im-provement is under way based on advanced small cells, cloud Radio Access Networks (RANs), ultra-dense networks, device-to-device (D2D) communication, wireless backhaul, moving network, cooperative communication, Coordinated Multi-Points (CoMP), reception-end interference cancellation and the like.

[5] In the 5G system, Hybrid FSK and QAM Modulation (FQAM) and sliding window superposition coding (SWSC) as an advanced coding modulation (ACM), and filter bank multi carrier (FBMC), non-orthogonal multiple access (NOMA), and sparse code multiple access (SCMA) as an advanced access technology have been developed.

[6] Modern mobile communications are tending to provide high speed transmission of multimedia services for users. FIG.1 is a schematic diagram illustrating a structure of an architecture evolution (SAE) system.

[7] In the system, a user equipment (UE) 101 is a terminal device which receives data. Evolved universal terrestrial radio access network (E-UTRAN) 102 is a wireless access network which includes eNodeBs/NodeBs which provide UEs with interfaces for accessing the wireless network. Mobility management entity (MME) 103 manages

mobility context, session context and security information of UEs. Service gateway (SGW) 104 provides user plane functions. MME 103 and SGW 104 may reside in the same physical entity. Packet data network (PDN) gateway (PGW) 105 implements functions including accounting, lawful interception and so on, and may reside in the same physical entity with SGW 104. Policy and charging rule functions (PCRF) 106 provides Quality of Service (QoS) policies and charging rules. Serving GPRS support node (SGSN) 108 is a network node device providing routing for data transmission in the Universal Mobile Telecommunications System (UMTS). Home Subscriber Server (HSS) 109 is a home sub system of the UE, and maintains user information including a current location of the UE, the address of the serving node, user security information, packet data context of the UE, and so on.

Disclosure of Invention

Technical Problem

[8] 3GPP Release 12 (Rel-12) proposes demands of enhanced small cells. Target scenarios of small cells enhancement include scenarios with macro cell coverage, scenarios without macro cell coverage, enhancement of indoor and outdoor backhaul, and enhancement of ideal or non-ideal backhaul, as shown in FIG. 2.

[9] A technique of performing carrier aggregation (CA) across different eNBs is proposed for scenarios with macro cell coverage. Macro cells and small cells may work at different frequencies. There are two technical frameworks for performing CA across different eNBs, i.e., user plane data in a radio access network (RAN) Split-based framework, and a core network (CN) Split-based framework. The CN Split-based framework refers to that, for a bearer established in a pico cell, user plane data is directly sent by an SGW in the CN to a pico cell instead of being forwarded by a macro cell.

[10] In a small cell, a UE may send and receive data to and from two eNBs at the same time, and this is referred to as dual-connectivity. Only one of the two eNBs is responsible for sending radio resource control (RRC) messages to the UE, and interacting with a mobility management entity (MME) in the CN, which is referred to as the master eNB (MeNB). The other of the two eNBs is referred to as a secondary eNB (SeNB). A cell of the MeNB is a primary cell (Pcell) of the UE. RRC messages are sent to the UE via the Pcell. Other cells of the MeNB are secondary cells (Scell) of the UE. One of the Scells of the SeNB is a primary SeNB cell (pScell) of the UE. The pScell has an uplink physical control channel that other Scells don't have. A cell group of the Pcell is referred to as a master cell group (MCG), and a cell group of Scells is referred to as a secondary cell group (SCG). Configurations of a Scell in the UE are configured by an SeNB. The SeNB sends configuration information for the UE to the

MeNB via an RRC container, and the MeNB sends the configuration information to the UE. The MeNB does not parse the RRC container. Alternatively, the MeNB may parse the RRC container without modifications to the configuration information in the RRC container.

[11] At present, there is no discussion on how to support local breakout in a dual-connectivity architecture.

Solution to Problem

[12] Various examples provide methods for supporting local breakout in a dual-connectivity architecture to implement setup, switching and correct releasing of local breakout bearer in a dual-connectivity architecture, so as to reduce the load of the core network of the operator.

[13] A method of de-activating local Internet protocol access (LIPA) bearer applicable for local breakout in a dual-connectivity architecture is provided. The method may include:

[14] triggering, by a master eNodeB (MeNB), an LIPA bearer de-activation process when determining to change a secondary eNodeB (SeNB) of a user equipment (UE) or to hand the UE over from the MeNB to an eNB, and then triggering a process of changing the SeNB of the UE or a process of handing the UE over from the MeNB to the eNB.

[15] In an example, the MeNB may send a request for releasing an LIPA bearer to the SeNB to trigger the LIPA bearer de-activation process.

[16] In an example, the request for releasing the LIPA bearer may include: an SeNB modification request or a defined message that includes a bearer identity of the LIPA bearer to be released.

[17] An apparatus corresponding to the above method is provided, and applicable for supporting local breakout in a dual-connectivity architecture. The apparatus may include: a control module, a bearer de-activation module and a handover module.

[18] The control module is configured to control the bearer de-activation module to trigger a local Internet Protocol access (LIPA) bearer de-activation process when the apparatus is a master eNodeB (MeNB) of a user equipment (UE) and determines to change a secondary eNodeB (SeNB) of the user or to hand the user over from the MeNB to an eNB, and control the handover module to trigger a process of changing the SeNB of the UE or a process of handing the UE over from the MeNB to the eNB.

[19] A method of de-activating local Internet protocol access (LIPA) bearers applicable for local breakout in a dual-connectivity architecture is provided. The method may include:

[20] sending, by a master eNodeB (MeNB) to a target secondary eNodeB (SeNB), an

SeNB addition request which comprises information excluding information of an LIPA bearer when the MeNB determines to change a SeNB of a user equipment (UE); and

[21] receiving, by the MeNB, an SeNB addition request confirm message from the target SeNB, and sending an SeNB release request to the source SeNB of the UE.

[22] In an example, the SeNB release request sent by the MeNB to the source SeNB of the UE may include information of an E-RABE-UTRAN Radio Access Bearer (E-RAB) to be released which includes an E-RAB identity of the E-RAB to be released and information for data forwarding; if the E-RAB is an LIPA bearer, the SeNB release request may include an indication indicative of the E-RAB to be released is the LIPA bearer.

[23] An apparatus corresponding to the above method is provided, and is applicable for supporting local breakout in a dual-connectivity architecture. The apparatus may include: a sending module and a receiving module.

[24] The sending module is configured to send a secondary eNodeB (SeNB) addition request to a target SeNB when the apparatus is a master eNodeB (MeNB) of a user equipment (UE) and determines to change a SeNB of the UE, wherein the SeNB addition request comprises information excluding information of a local Internet Protocol access (LIPA) bearer.

[25] The receiving module is configured to receive an SeNB addition request confirm message from the target SeNB.

[26] The sending module is further configured to send an SeNB release request to a source SeNB of the UE.

[27] A method of de-activating a local Internet protocol access (LIPA) bearer applicable for local breakout in a dual-connectivity architecture is provided. The method may include:

[28] sending, by a master eNodeB (MeNB) to a target eNB, a handover request which comprises information excluding information of an LIPA bearer when the MeNB determines to hand a user equipment (UE) from the MeNB to the target eNB ; and

[29] receiving, by the MeNB, an handover request confirm message from the target eNB, and sending an SeNB release request to a source SeNB of the UE.

[30] In an example, the SeNB release request sent by the MeNB to the source SeNB of the UE may include information of an E-RAB to be released which includes an E-RAB identity of the E-RAB to be released and information for data forwarding; when the E-RAB is an LIPA bearer, the SeNB release request may include an indication indicative of the E-RAB to be released is the LIPA bearer.

[31] An apparatus corresponding to the above method is provided, and is applicable for supporting local breakout in a dual-connectivity architecture. The apparatus may include: a sending module and a receiving module.

[32] The sending module is configured to send a handover request to a target eNB when the apparatus is a master eNodeB (MeNB) of a user equipment (UE) and determines to hand the UE over from the MeNB to the target eNB, wherein the handover request comprises information excluding information of a local Internet Protocol access (LIPA) bearer.

[33] The receiving module is configured to receive an handover request confirm message from the target eNB.

[34] The sending module is further configured to send an SeNB release request to a source SeNB of the UE.

[35] A method of de-activating a local Internet protocol access (LIPA) bearer applicable for local breakout in a dual-connectivity architecture is provided. The method may include:

[36] receiving, by a secondary eNodeB (SeNB), a request for releasing a LIPA bearer from a master eNodeB (MeNB); and

[37] activating a LIPA bearer de-activation process in a local gateway (LGW) through internal signaling.

[38] In an example, the request for releasing the LIPA bearer may include: an SeNB modification request or a defined request message that includes a bearer identity of the LIPA bearer to be released.

[39] An apparatus corresponding to the above method is provided, and is applicable for supporting local breakout in a dual-connectivity architecture. The apparatus may include: a receiving module and a bearer de-activation module.

[40] The receiving module is configured to receive a request for releasing a local Internet Protocol access (LIPA) bearer from a master eNodeB (MeNB) when the apparatus is a secondary eNodeB (SeNB) of a user equipment (UE).

[41] The bearer de-activation module is configured to trigger a LIPA bearer de-activation process in a local gateway (LGW) through internal signaling.

[42] A method of switching bearers applicable for supporting local breakout in a dual-connectivity architecture with selected Internet Protocol traffic offload (SIPTO) standalone architecture is provided. The method may include:

[43] sending, by a master eNodeB (MeNB), an E-UTRAN Radio Access Bearer (E-RAB) modification request to a mobility management entity (MME) when the MeNB determines to switch a local breakout bearer, wherein the E-RAB modification request comprises a local network identity of a target eNB that the local breakout bearer to be switched to or information indicative of that the local offload bearer is switched out the source local home network, or the E-RAB modification request comprises an identity of the local breakout bearer and an identity of a target local home network to which the local breakout bearer is to be switched; and

[44] receiving, by the MeNB, an E-RAB modification request confirm message from the MME.

[45] In an example, if the MeNB determines to switch the local breakout bearer from a first secondary eNodeB (SeNB) to a second SeNB, the method may also include:

[46] sending, by a master eNodeB (MeNB), an E-UTRAN Radio Access Bearer (E-RAB) modification request to a mobility management entity (MME) when the MeNB determines to switch a local breakout bearer, wherein the E-RAB modification request comprises a local network identity of a target eNB that the local breakout bearer to be switched to or information indicative of that the local offload bearer is switched out the source local home network, or the E-RAB modification request comprises an identity of the local breakout bearer and an identity of a target local home network to which the local breakout bearer is to be switched; and

[47] receiving, by the MeNB, an E-RAB modification request confirm message from the MME.

[48] An apparatus corresponding to the above method is provided, and is applicable for supporting local breakout in a dual-connectivity architecture. The apparatus may include: a bearer modification module and a receiving module.

[49] the bearer modification module is configured to send an E-UTRAN Radio Access Bearer (E-RAB) modification request to a mobility management entity (MME) when the apparatus serves as a master eNodeB (MeNB) of a user equipment (UE) and determines to switch a local breakout bearer, wherein the E-RAB modification request comprises a local network identity of a target eNB to which the local breakout bearer is to be switched or information indicative of that the local breakout bearer is to be switched out the source local home network, or the E-RAB modification request comprises an identity of the local breakout bearer and an identity of a target local home network that the local breakout bearer to be switched to; and

[50] the receiving module is configured to receive an E-RAB modification request confirm message from the MME.

[51] A method of switching bearers applicable for supporting local breakout in a dual-connectivity architecture with selected Internet Protocol traffic offload (SIPTO) standalone architecture is provided. The method may include:

[52] obtaining, by a master eNodeB (MeNB), a local network identity of a target eNB when the MeNB determines to switch a local breakout bearer; and

[53] sending, by the MeNB to a mobility management entity (MME), an E-RAB release request which includes an E-RAB identity of a SIPTO bearer to be released if the target eNB is in a local home network different from a local home network of a source eNB.

[54] In an example, the MeNB may obtain the local network identity of the target eNB in

a manner selected from the following:

[55] sending, by the MeNB to a target secondary eNodeB (SeNB), an SeNB addition request which includes a local breakout indication; receiving, by the MeNB, an SeNB addition request confirm message from the target SeNB and obtaining a local home network identity of the target SeNB from the SeNB addition request confirm message;

[56] obtaining, by the MeNB, the local home network identity of the target eNB from an X2 setup process, wherein an X2 setup request sent during the X2 setup process includes a local home network identity of an eNB that sent the X2 setup request, and an X2 setup response sent during the X2 setup process includes a local home network identity of an eNB that sent the X2 setup response; and

[57] obtaining, by the MeNB, the local home network identity of the target eNB through automatic neighbour relation (ANR).

[58] An apparatus corresponding to the above method is provided, and is applicable for supporting local breakout in a dual-connectivity architecture. The apparatus may include: an identity obtaining module and a bearer releasing module.

[59] the identity obtaining module is configured to obtain a local home network identity of a target eNB if the apparatus serves as a master eNodeB (MeNB) of a user equipment UE and determines to switch a local breakout bearer; and

[60] the bearer releasing module is configured to send to a mobility management entity (MME), an E-UTRAN Radio Access Bearer (E-RAB) release request which includes an E-RAB identity of a SIPTO bearer to be released if the target eNB is in a local home network different from a local home network of a source eNB.

[61] A method of establishing local Internet protocol access (LIPA) bearers is applicable for local breakout in a dual-connectivity architecture. The method may include:

[62] receiving, by a master eNodeB (MeNB), a non-access stratum (NAS) message from a user equipment (UE);

[63] sending, by the MeNB to a mobility management entity (MME), an initial UE message or an uplink direct transfer message which includes the NAS message received from the UE; including, by the MeNB, an IP address of a collocated local gateway (LGW) of the MeNB if the MeNB has the collocated LGW or an IP address of a collocated LGW of a secondary eNodeB (SeNB) of the UE if the SeNB has the collocated LGW;

[64] receiving, by the MeNB from the MME, an initial context setup request or an E-RAB setup request message which includes a correlation ID corresponding to a LIPA bearer to be established; and

[65] sending, by the MeNB, an SeNB addition request to the SeNB.

[66] In an example, if the bearer to be established is a secondary cell group (SCG) bearer, the MeNB may set an uplink tunnel end identity (TEID) of the SCG bearer in the

SeNB addition request as the correlation ID, and set a transport layer address of the SCG bearer in the SeNB addition request as the IP address of the LGW; if the bearer to be established is a split bearer, the MeNB may allocate an uplink TEID and a transport layer address of an X2 interface to the split bearer.

[67] An apparatus corresponding to the above method is provided, and is applicable for supporting local breakout in a dual-connectivity architecture. The apparatus may include: a first module, a second module, a third module and a fourth module.

[68] the first module is configured to receive a non-access stratum (NAS) message from a user equipment (UE);

[69] the second module is configured to send to a mobility management entity (MME) an initial UE message or an uplink direct transfer message which includes the NAS message received from the UE; including an IP address of a collocated local gateway (LGW) of the MeNB if the MeNB has the collocated LGW or an IP address of a collocated LGW of a secondary eNodeB (SeNB) of the UE if the SeNB has the collocated LGW;

[70] the third module is configured to receive from the MME an initial context setup request or an E-UTRAN Radio Access Bearer (E-RAB) setup request message which includes a correlation ID corresponding to a local Internet protocol access (LIPA) bearer to be established; and

[71] the fourth module is configured to send an SeNB addition request to the SeNB.

[72] According to the above technical mechanism, the method of supporting local breakout in a dual-connectivity architecture may implement setup, switch and correct releasing of local breakout bearer in a dual-connectivity architecture, so as to reduce the load of the core network of the operator. The technical mechanism can address the following issues.

[73] 1) De-activating a LIPA bearer during movement of UE using LIPA for local breakout in a dual-connectivity architecture.

[74] 2) Establishing a bearers if LGW is in an MeNB when SIPTO collocated architecture and LIPA are supported.

[75] 3) Implementing switching and de-activation of a bearer in SIPTO standalone architecture.

Advantageous Effects of Invention

[76] Various examples provide methods for supporting local breakout in a dual-connectivity architecture to implement setup, switching and correct releasing of local breakout bearer in a dual-connectivity architecture, so as to reduce the load of the core network of the operator.

Brief Description of Drawings

[77] FIG.1 is a schematic diagram illustrating a structure of a conventional SAE system;

[78] FIG. 2 is a schematic diagram illustrating a scenario deployed with enhanced small cells;

[79] FIG. 3 is a schematic diagram illustrating a first method of de-activating a LIPA bearer when LIPA is used for local breakout in a dual-connectivity architecture in accordance with an example of the present disclosure;

[80] FIG. 4 is a schematic diagram illustrating a second method of de-activating a LIPA bearer when a bearer of a UE is switched between different SeNBs when LIPA is used for local breakout in a dual-connectivity architecture in accordance with an example of the present disclosure;

[81] FIG. 5 is a schematic diagram illustrating a second method of de-activating a LIPA bearer when a bearer of a UE is switched from an MeNB to an eNB when LIPA is used for local breakout in a dual-connectivity architecture in accordance with an example of the present disclosure;

[82] FIG. 6 is a schematic diagram illustrating a first method of switching bearer when SIPTO standalone architecture is used for local breakout in a dual-connectivity architecture in accordance with an example of the present disclosure;

[83] FIG. 7 is a schematic diagram illustrating a second method of switching bearer when SIPTO standalone architecture is used for local breakout in a dual-connectivity architecture in accordance with an example of the present disclosure;

[84] FIG. 8 is a schematic diagram illustrating a method of establishing a SIPTO bearer or a LIPA bearer supporting local breakout in a dual-connectivity architecture.

Best Mode for Carrying out the Invention

[85] In order to make the objectives, technical schemes and merits of the present invention clearer, a detailed description of the present invention is hereinafter given with reference to specific embodiments.

[86] At present, techniques supporting local breakout include local Internet protocol access (LIPA) and selected Internet protocol traffic offload (SIPTO). There are still problems to be solved to apply LIPA or SIPTO in a dual-connectivity architecture. For example:

[87] how to de-activate a LIPA bearer during movement of UEs using LIPA for local breakout in a dual-connectivity architecture;

[88] how to establish a SIPTO bearer if LGW is collocated in an MeNB when SIPTO collocated architecture and LIPA are supported; and

[89] how to switch and de-activate a SIPTO bearer in a SIPTO standalone architecture.

[90] Various examples provide a technical solution to the above problems.

[91] FIG. 3 is a schematic diagram illustrating a first method of de-activating a LIPA

bearer when LIPA is used for local breakout in a dual-connectivity architecture in accordance with an example of the present disclosure. The method solves a problem of how to release a LIPA bearer when a UE is handed over between different SeNBs or a UE is handed over from an MeNB to an eNB when LIPA is supported in a dual-connectivity architecture and a LGW is in an SeNB. The method of FIG. 3 may include the following procedures.

[92] At block 301, an MeNB may send a request for releasing a LIPA bearer to an SeNB.

[93] When the MeNB determines to change a serving SeNB of a UE or initiate a handover from the MeNB to an eNB, the MeNB may determine there is a LIPA bearer established at an SeNB according to information stored previously. The MeNB may perform the procedure of block 301 to send a request to the SeNB for releasing the LIPA bearer. The request may include a bearer identity of the LIPA bearer to be released. The request may be an SeNB modification request or a defined message.

[94] At block 302, the SeNB may send a release request confirm message to the MeNB.

[95] The release request confirm message may include SCG configuration information of the bearer to be released. The release request confirm message may be an SeNB modification request confirm message or a defined message.

[96] In an example, the MeNB may initiate a process to release the LIPA bearer established at the SeNB for the UE, i.e., performing procedures in blocks 303 and 304. In an example, the MeNB may initiate the process to release the LIPA bearer established at the SeNB for the UE after receiving an E-UTRAN Radio Access Bearer (E-RAB) release command from a mobility management entity (MME), i.e., skipping blocks 303 and 304 and directly performing the procedure in block 305.

[97] At block 303, the MeNB may send an RRC connection reconfiguration message to the UE requesting the UE to release the LIPA bearer. The RRC connection reconfiguration message may include SCG configuration information received from the SeNB.

[98] At block 304, the UE may send an RRC connection reconfiguration complete message to the MeNB.

[99] At block 305, the SeNB may send internal signaling to the LGW requesting to release the LIPA bearer.

[100] At block 306, the LGW may send a bearer release request to an SGW. The message may include a bearer identity of the LIPA bearer to be released.

[101] At block 307, the SGW may send a bearer release request to the MME. The bearer release request may include a bearer identity of the LIPA bearer to be released.

[102] At block 308, the MME may send an E-RAB release command to the MeNB. The E-RAB release command may include the bearer identity of the LIPA bearer to be released. The E-RAB release command may include a non-access stratum (NAS)

protocol data unit (PDU) for instructing the UE to release an evolved packet system (EPS) bearer.

[103] If the MeNB has performed the procedures in blocks 303 and 304 to release the LIPA bearer at the UE, the MeNB may send a direct transfer message to the UE in block 309 to send the NAS PDU received from the MME to the UE. If the MeNB did not perform the procedures in blocks 303 and 304, the MeNB may send to the UE an RRC connection reconfiguration message which includes SCG configuration information received from the SeNB.

[104] At block 309b, the UE may send an RRC connection reconfiguration complete message to the MeNB. This procedure is performed only when the UE has received an RRC connection reconfiguration message.

[105] At block 310, the UE may send a direct transfer message to the MeNB. The direct transfer message may include the NAS message of delete EPS bearer context accept.

[106] If the MeNB has performed the procedures in blocks 303 and 304 to release the LIPA bearer at the UE, the procedures in blocks 309, 309b and 310 may be skipped.

[107] At block 311, the MeNB may send an E-RAB release response to the MME. If the MeNB has performed the procedures in blocks 303 and 304 to release the LIPA bearer at the UE, the MeNB may perform this procedure after receiving the release command in block 308.

[108] At block 312, the MeNB may send an uplink NAS transfer message to the MME to send the NAS message received from the UE to the MME.

[109] At block 313, the MeNB may initiate an SeNB change process or a handover process from the MeNB to the eNB.

[110] According to the method as shown in FIG. 3, when the MeNB determines to change the serving SeNB of the UE or to hand the UE over from the MeNB to the eNB, the MeNB may firstly send a message to the SeNB to initiate a LIPA bearer de-activation process, then initiate the process for changing the SeNB or for handover from the MeNB to the eNB so as to timely release the LIPA bearer.

[111] Various examples also provide an apparatus corresponding to the method of FIG. 3. The apparatus is applicable for supporting local breakout in a dual-connectivity architecture. The apparatus may include: a control module, a bearer de-activation module and a handover module.

[112] The control module is configured to control the bearer de-activation module to trigger a local Internet Protocol access (LIPA) bearer de-activation process when the apparatus is a master eNodeB (MeNB) of a user equipment (UE) and determines to change a serving secondary eNodeB (SeNB) of the UE or to hand the UE over from the MeNB to an eNB, and control the handover module to trigger a process of changing the serving SeNB of the UE or a process of handing the UE over from the

MeNB to the eNB.

[113] In an example, the bearer de-activation module may send a request for releasing an LIPA bearer to the SeNB to trigger the LIPA bearer de-activation process.

[114] In an example, the request message for releasing the LIPA bearer may be: an SeNB modification request or a defined message which includes a bearer identity of the LIPA bearer to be released.

[115] FIG. 4 is a schematic diagram illustrating a second method of de-activating a LIPA bearer when a LIPA bearer of a UE is switched between different SeNBs when LIPA is used for local breakout in a dual-connectivity architecture in accordance with an example of the present disclosure. The method solves a problem of how to release a LIPA bearer when a UE is handed over between different SeNBs when LIPA is supported in a dual-connectivity architecture and a LGW is in an SeNB. The method of FIG. 4 may include the following procedures.

[116] At block 401, an MeNB may send an SeNB addition request to a target SeNB.

[117] When the MeNB determines to change the serving SeNB of the UE, the MeNB may determine there is a LIPA bearer established at the SeNB according to information previously stored, and send the SeNB addition request to the target SeNB. The SeNB addition request may include bearer information excluding information of the LIPA bearer.

[118] At block 402, the target SeNB may send an SeNB addition request confirm message to the MeNB.

[119] At block 403, the MeNB sends an SeNB release request to the source SeNB.

[120] The SeNB modification request may include information of an E-RAB to be released. The information of the E-RAB to be released may include an E-RAB identity of the E-RAB to be released and information for data forwarding. If the bearer to be released is a LIPA bearer, the SeNB modification request may also include information indicating the E-RAB to be released is a LIPA bearer.

[121] In an example, the MeNB may initiate a process for reconfiguring the UE, i.e., performing the procedures in blocks 404 and 405 denoted by dotted lines. In an example, the MeNB may initiate the process for reconfiguring the UE after receiving an E-RAB release command sent by an MME, i.e., skipping the procedures in blocks 404 and 405 denoted by dotted lines and performing the procedure in block 405b directly.

[122] At block 404, the MeNB may send an RRC connection reconfiguration message to the UE requesting the UE to modify configurations of the bearer and/or to release the LIPA bearer. The RRC connection reconfiguration message may include SCG configuration information received from the SeNB.

[123] At block 405, the UE may send an RRC connection reconfiguration complete

message to the MeNB.

[124] At block 405b, the SeNB may send internal signaling to an LGW requesting to release the LIPA bearer.

[125] At block 406, the LGW may send a bearer release request to an SGW. The bearer release request may include a bearer identity of the LIPA bearer to be released.

[126] At block 407, the SGW may send a bearer release request to the MME. The bearer release request may include a bearer identity of the LIPA bearer to be released.

[127] At block 408, the MME may send an E-RAB release command to the MeNB. The E-RAB release command may include the E-RAB identity of the E-RAB to be released. The E-RAB release command may also include a NAS PDU for instructing the UE to release an EPS bearer.

[128] If the MeNB has performed the procedures in blocks 404 and 405 to reconfigure the LIPA bearer at the UE, the MeNB may send a direct transfer message to the UE in block 409 to send the NAS PDU received from the MME to the UE. If the MeNB did not perform the procedures in blocks 404 and 405, the MeNB may send to the UE an RRC connection reconfiguration message which includes the SCG configuration information received from the SeNB.

[129] At block 409b, the UE may send an RRC connection reconfiguration complete message to the MeNB. This procedure is performed only when the UE has received an RRC connection reconfiguration message.

[130] At block 410, the MeNB may send an E-RAB release response to the MME. If the MeNB has performed the procedures in blocks 404 and 405 to reconfigure the bearer at the UE, the MeNB may perform this procedure after receiving the release command in block 408.

[131] At block 411, the UE may send a direct transfer message to the MeNB. The direct transfer message may include the NAS message of delete EPS bearer context accept.

[132] If the MeNB has performed the procedures in blocks 404 and 405 to configure the bearer at the UE, the procedures in blocks 409, 409b and 411 may be skipped.

[133] At block 412, the MeNB may send an uplink NAS transfer message to the MME to send the NAS message received from the UE to the MME.

[134] At block 413, the MeNB may send an SeNB reconfiguration complete message to the target SeNB.

[135] At block 414, the UE may perform random access to be synchronized with the target SeNB.

[136] At block 415, the serving SeNB may send a Sequence Number (SN) status transfer message to the MeNB, and the MeNB may send the SN status transfer message to the target SeNB.

[137] At block 416, data on an SCG bearer may be forwarded by the source SeNB. The

source SeNB may start forwarding data after receiving the SeNB release request.

[138] At blocks 417 to 419, if a bearer is configured to be an SCG bearer at the source SeNB, the MeNB may initiate a path switch process. In an example, the MeNB may send an E-RAB modification indication to the MME. The MME may modify the bearer with the SGW, and return an E-RAB modification confirm message to the MeNB.

[139] At block 420, the MME may send a UE context release command to the source SeNB.

[140] According to the method as shown in FIG. 4, when a UE is handed over between different SeNBs, the MeNB may configure in the target SeNB only the bearers other than LIPA bearer. The source SeNB may instruct the LGW to initiate a LIPA bearer de-activation process through internal signaling after receiving an SeNB release request, so as to timely release the LIPA bearer.

[141] Various examples provide an apparatus corresponding to the method as shown in FIG. 4. The apparatus is applicable for supporting local breakout in a dual-connectivity architecture. The apparatus may include: a sending module and a receiving module.

[142] The sending module is configured to send an SeNB addition request to a target SeNB when the apparatus is an MeNB of a UE and determines to change a serving SeNB of the UE, wherein the SeNB addition request comprises bearer information excluding information of a LIPA bearer.

[143] The receiving module is configured to receive an SeNB addition request acknowledgement from the target SeNB.

[144] The sending module is further configured to send an SeNB release request to a source SeNB of the UE.

[145] In an example, the SeNB release request sent by the sending module to the source SeNB of the UE may include information of an E-RAB to be released which includes an E-RAB identity of the E-RAB to be released and information for data forwarding; if the E-RAB is an LIPA bearer, the SeNB release request may include an indication to indicate that the E-RAB to be released is the LIPA bearer.

[146] FIG. 5 is a schematic diagram illustrating a second method of de-activating a LIPA bearer when a bearer of a UE is switched from an MeNB to an eNB when LIPA is used for local breakout in a dual-connectivity architecture in accordance with an example of the present disclosure. The method of FIG. 5 may include the following procedures.

[147] At block 501, an MeNB may send an handover request to a target eNB.

[148] When the MeNB determines to hand a UE over to the target eNB, the MeNB may determine there is a LIPA bearer established at the SeNB according to information previously stored, and send the handover request to the target eNB. The handover request may include information excluding information of the LIPA bearer.

[149] At block 502, the target eNB may send an handover request confirm message to the MeNB.

[150] At block 503, the MeNB may send an SeNB release request to the source SeNB. The SeNB release request may include information of an E-RAB to be released. The information of the E-RAB to be released may include an E-RAB identity of the E-RAB to be released and information for data forwarding. If the bearer to be released is a LIPA bearer, the SeNB release request may also include information indicating the E-RAB to be released is a LIPA bearer.

[151] At block 504, the source SeNB may send internal signaling to an LGW requesting the LGW to release the LIPA bearer.

[152] At block 505, the LGW may send a bearer release request to an SGW. The bearer release request may include a bearer identity of the LIPA bearer to be released.

[153] At block 506, the SGW may send a bearer release request to an MME. The bearer release request may include a bearer identity of the LIPA bearer to be released.

[154] At block 507, the MME may send an E-RAB release command to the MeNB. The E-RAB release command may include the E-RAB identity of the E-RAB to be released. The E-RAB release command may also include a NAS PDU for instructing the UE to release an EPS bearer.

[155] At block 508, the MeNB may send an RRC connection reconfiguration message to the UE. The RRC connection reconfiguration message may include the NAS message received from the MME.

[156] At block 509, the UE may send an RRC connection reconfiguration complete message to the MeNB.

[157] At block 510, the MeNB may send an E-RAB release response to the MME.

[158] At block 511, the UE may send a direct transfer message to the MeNB. The direct transfer message may include the NAS message of delete EPS bearer context accept.

[159] At block 512, the MeNB may send an uplink NAS transfer message to the MME to send the NAS message received from the UE to the MME.

[160] At block 513, the MeNB may send an RRC connection reconfiguration message to the UE requesting the UE to modify configurations of the bearer.

[161] At block 514, the UE may perform random access to be synchronized with the target SeNB.

[162] At block 515, the UE may send an RRC connection reconfiguration complete message to the target eNB.

[163] At block 516, the source SeNB may send an SN status transfer message to the MeNB, and the MeNB may send the SN status transfer message to the target eNB.

[164] At block 517, the target eNB may send a path switch request to an MME.

[165] At block 518, the MME may initiate a bearer modification process with SGW.

[166] At block 519, the MME may send a path switch request confirm message to target eNB.

[167] At block 520, the target eNB may send a UE context release command to the MeNB.

[168] At block 521, the MeNB may send a UE context release message to the SeNB.

[169] According to the method as shown in FIG. 5, when a UE is handed over from the MeNB to the eNB, the MeNB may configure in the target SeNB only the bearers other than LIPA bearer. The source SeNB may instruct the LGW to initiate a LIPA bearer de-activation process through internal signaling after receiving an SeNB release request, so as to timely release the LIPA bearer.

[170] Various examples provide an apparatus corresponding to the method as shown in FIG. 5. The apparatus is applicable for supporting local breakout in a dual-connectivity architecture. The apparatus may include: a sending module and a receiving module.

[171] The sending module is configured to send an SeNB handover request to a target eNB when the apparatus is an MeNB of a UE and determines to hand the UE over from the MeNB to the target eNB, wherein the SeNB handover request comprises information excluding information of a LIPA bearer.

[172] The receiving module is configured to receive an SeNB handover request confirm message from the target eNB.

[173] The sending module is further configured to send an SeNB release request to a source SeNB of the UE.

[174] In an example, the SeNB release request sent by the sending module to the source SeNB of the UE may include information of an E-RAB to be released which includes an E-RAB identity of the E-RAB to be released and information for data forwarding; when the E-RAB is an LIPA bearer, the SeNB release request may include an indication indicative of the E-RAB to be released is the LIPA bearer.

[175] Various examples provide an apparatus corresponding to the method as shown in FIGs. 3-5. The apparatus is applicable for supporting local breakout in a dual-connectivity architecture. The apparatus may include: a receiving module and a bearer de-activation module.

[176] The receiving module is configured to receive a request for releasing a LIPA bearer from an MeNB when the apparatus is an SeNB of a UE.

[177] The bearer de-activation module is configured to trigger a LIPA bearer de-activation process in a LGW through internal signaling.

[178] FIG. 6 is a schematic diagram illustrating a first method of switching bearer when SIPTO standalone architecture is used for local breakout in a dual-connectivity architecture in accordance with an example of the present disclosure. The method adopts a SIPTO standalone architecture. Some procedures irrelevant to implementation of the technical mechanism are omitted in FIG. 6. The method may include the following

procedures.

[179] At block 600, an MeNB determines to switch a local breakout bearer.

[180] In an example, the MeNB may determine to switch the local breakout bearer to another SeNB or to the MeNB in response to a determination that the SeNB (e.g., SeNB1, or first SeNB) becomes unavailable according to measurement results of the UE or the SeNB has too much load.

[181] At block 601, if the MeNB determines to switch the local breakout bearer to another SeNB (e.g., SeNB2, or second SeNB), the MeNB may send an SeNB addition request to SeNB2.

[182] The SeNB addition request may include a local breakout indication. SeNB2 may determine according to the local breakout indication whether to send a local network identity of SeNB2 to the MeNB at block 602.

[183] At block 602, SeNB2 may allocate resources, and send an SeNB addition request confirm message to the MeNB.

[184] The SeNB addition request confirm message may include the local home network identity of SeNB2.

[185] If the MeNB determines to switch the local breakout bearer to the MeNB, the procedure in blocks 601, 602 and 604 may be skipped.

[186] At block 603, the MeNB may send an RRC reconfiguration request to the UE, and the UE may send an RRC reconfiguration response to the MeNB.

[187] At block 604, the MeNB may send an SeNB reconfiguration complete message to SeNB2.

[188] At block 605, the MeNB may send an E-RAB modification request to an MME. In an example, the MeNB may send the local home network identity of the target eNB (SeNB2 or MeNB) or information indicating the local breakout bearer is to be switched out of the source local network to the MME via the E-RAB modification request. In an example, the MeNB may send the identity of the local breakout bearer, or the identity of the local breakout bearer and the identity of the target local home network to which the local breakout bearer is to be switched to the MME. Therefore, the local home network identity in the E-RAB modification request may be corresponding to each bearer. The information of the modified bearer may include the identity of the bearer to be modified, and the identity of the target local home network to which the bearer is to be switched.

[189] In an example, the MeNB may obtain the local home network identity of SeNB2 during an X2 setup process. In an example, the MeNB may obtain the local home network identity of SeNB2 in block 602. In an example, the MeNB may have the local home network identity of the source SeNB (e.g., SeNB1) and the local home network identity of the target SeNB (e.g., SeNB2), and send the indication of switching the

bearer out of the local network to the MME. The MeNB may send the indication of switching the bearer out of the local network to the MME only when the bearer of the UE is a local breakout bearer and the local breakout bearer is to be switched out of the local home network. The indication of switching the bearer out of the local home network may be sent for each bearer. The information of the modified bearer may include the identity of the bearer to be modified, and the identity of the local home network to which the bearer is to be switched.

[190] At block 606, the MME may send a bearer modification request to the SGW/LGW, and the SGW/LGW may send a bearer modification response to the MME.

[191] At block 607, the MME may send an E-RAB modification confirm message to the MeNB.

[192] If the bearer is a local breakout bearer, the MME may initiate a local breakout bearer de-activation process in response to a determination that the local breakout bearer is switched out of the local home network according to information received from the MeNB, e.g., according to the local home network identity of the target eNB to which the bearer is to be switched or the indication of switching the local breakout bearer out of the local home network. The MME may perform or skip the procedures in blocks 606 and 607 when initiating the local bearer de-activation process. The bearer de-activation process is not elaborated herein.

[193] Various examples provide an apparatus corresponding to the method as shown in FIG. 6. The apparatus is applicable for supporting local breakout in a dual-connectivity architecture with a SIPTO standalone architecture. The apparatus may include: a bearer modification module and a receiving module.

[194] The bearer modification module is configured to send an E-RAB modification request to an MME when the apparatus serves as an MeNB of a UE and determines to switch a local breakout bearer, wherein the E-RAB modification request comprises a local home network identity of a target eNB to which the local breakout bearer is to be switched or information indicative of that the local breakout bearer is to be switched out the source local home network, or the E-RAB modification request comprises an identity of the local breakout bearer and an identity of a target local home network that the local breakout bearer to be switched to.

[195] The receiving module is configured to receive an E-RAB modification request acknowledgement from the MME.

[196] In an example, if the MeNB determines to switch the local breakout bearer from a first SeNB to a second SeNB, the method may also include:

[197] before sending the E-RAB modification request to the MME, sending, by the MeNB to the second SeNB, an SeNB addition request which includes a local breakout indication; and

[198] receiving, by the MeNB from the second SeNB, an SeNB addition request acknowledgement, and obtaining a local home network identity of the second SeNB from the SeNB addition request acknowledgement.

[199] FIG. 7 is a schematic diagram illustrating a second method of switching bearer when SIPTO standalone architecture is used for local breakout in a dual-connectivity architecture in accordance with an example of the present disclosure. The method is a process of implementing local breakout bearer de-activation when a local breakout bearer is to be switched (including switching from an MeNB to an SeNB, or from an SeNB to an MeNB, or from an SeNB to another SeNB) when a SIPTO standalone architecture is adopted. Some procedures irrelevant to implementation of the technical mechanism are omitted in FIG. 7. The method may include the following procedures.

[200] At block 700, an MeNB determines to switch a local breakout bearer.

[201] For example, it may be determined that the SeNB (e.g., SeNB1, or first SeNB) to which the local breakout bearer belongs becomes unavailable according to measurement results of the UE or becomes overloaded. The MeNB determines to switch the local breakout bearer to a second SeNB or to the MeNB.

[202] At block 701, the MeNB may obtain the local network identity (LHN ID) of the target eNB.

[203] The MeNB may obtain the LHN ID of the target eNB in an X2 setup process. In this manner, an X2 setup request and an X2 setup response may include the LHN ID of the source eNB (i.e., the eNB that sends either of the two messages).

[204] The MeNB may obtain the LHN ID of the target eNB in an SeNB addition process. In this manner, the SeNB addition request confirm message sent during the SeNB addition process (e.g., procedures in blocks 602 as shown in FIG. 6) may include the LHN ID of the SeNB.

[205] The MeNB may also obtain the LHN ID of the target eNB from automatic neighbour relation (ANR). In this manner, an eNB may broadcast the LHN ID of the eNB, and a UE may obtain the LHN ID of a neighboring eNB and send the LHN ID to the source eNB of the UE.

[206] At block 702, the MeNB may obtain the LHN ID of the source eNB and the LHN ID of the target eNB to which the bearer is to be switched. If the source eNB is in a different local network with the target eNB (i.e., they have different LHN IDs), the MeNB may send an E-RAB release request to an MME. The SeNB release request may include an E-RAB ID of a SIPTO bearer to be released.

[207] At block 703, the MME may initiate a process for de-activating the SIPTO bearer.

[208] At block 704, the MeNB may initiate a switch process. The switch process may refer to a process of switching a bearer (e.g., switching a bearer from the MeNB to an SeNB, or from a first SeNB to a second SeNB, or from an SeNB to the MeNB).

[209] According to the method as shown in FIG. 7, the MeNB may initiate the de-activation of the SIPTO bearer to avoid a waste of resources resulted from switching the SIPTO bearer to an eNB and then de-activating the SIPTO bearer.

[210] An apparatus corresponding to the method as shown in FIG. 7 is provided. The apparatus may be applicable for supporting local breakout in a dual-connectivity architecture. The apparatus may include: an identity obtaining module and a bearer releasing module.

[211] The identity obtaining module is configured to obtain a local network identity of a target eNB if the apparatus serves as an MeNB of a UE and determines to switch a local breakout bearer.

[212] The bearer releasing module is configured to send to an MME, an E-RAB release request which includes an E-RAB identity of a SIPTO bearer to be released if the target eNB is in a local network different from a local network of a source eNB.

[213] In an example, the MeNB may obtain the local network identity of the target eNB in a manner selected from the following:

[214] sending, by the MeNB to a target SeNB, an SeNB addition request which includes a local breakout indication; receiving, by the MeNB, an SeNB addition request acknowledgement from the target SeNB and obtaining a local network identity of the target SeNB from the SeNB addition request confirm message;

[215] obtaining, by the MeNB, the local network identity of the target eNB from an X2 setup process, wherein an X2 setup request sent during the X2 setup process includes a local network identity of an eNB that sent the X2 setup request, and an X2 setup response sent during the X2 setup process includes a local network identity of an eNB that sent the X2 setup response; and

[216] obtaining, by the MeNB, the local network identity of the target eNB through ANR.

[217] FIG. 8 is a schematic diagram illustrating a method of establishing a SIPTO bearer or a LIPA bearer in a dual-connectivity architecture supporting a SIPTO collocated architecture. The method is for establishing a LIPA bearer or a SIPTO bearer in a dual-connectivity architecture supporting LIPA or a SIPTO collocated architecture. The method of FIG. 8 may include the following procedures.

[218] At block 801, the UE may send a NAS message to the MeNB via an RRC message.

[219] At block 802, the MeNB may send an initial UE message or an uplink direct transfer message to an MME. The message may include the NAS message received from the UE.

[220] If the MeNB has a collocated LGW, the MeNB may send the LGW IP of the collocated LGW to the MME via the initial UE message or the uplink direct transfer message. If the SeNB of the UE has a collocated LGW, the MeNB may send the LGW IP of the collocated LGW at the SeNB to the MME via the initial UE message or the

uplink direct transfer message. In an example, the SeNB of the UE is the SeNB that the MeNB configured a bearer at the SeNB for the UE. In another example, the SeNB of the UE may be the SeNB that the MeNB detects the UE is in the coverage of the SeNB according to measurement results of the UE.

[221] If the MeNB has a collocated LGW, the MeNB may send the LGW IP of the collocated LGW at the MeNB to the MME. If the MeNB does not have a collocated LGW, the MeNB may send an LGW IP of the SeNB of the UE to the MME.

[222] At block 803, the MME may send a session setup request to the SGW. According to the NAS message received, if the UE has requested a local breakout service, e.g., a SIPTO service or a LIPA service in the local network, the MME may determine whether to establish a SIPTO bearer or a LIPA bearer according to subscription information of the UE and the LGW IP received from the MeNB. The MME may select a LGW for the UE according to a principle after determining to establish a SIPTO bearer or a LIPA bearer for the UE.

[223] At block 804, the SGW may send a session setup request to the LGW.

[224] At block 805, the LGW may send a session setup response to the SGW.

[225] At block 806, the SGW may send a session setup response to the MME.

[226] At block 807, the MME may send an initial context setup request or an E-RAB setup request to the MeNB. The initial context setup request or the E-RAB setup request may include a correlation ID of the SIPTO bearer or the LIPA bearer to be established.

[227] At block 808, the MeNB may send an SeNB addition request to an SeNB. The MeNB sets an uplink TEID and transport layer address information of the bearer in the SeNB addition request according to whether the bearer to be established is an SCG bearer or a split bearer. If the bearer to be established is a secondary cell group (SCG) bearer, the MeNB may set an uplink tunnel end identity (TEID) of the SCG bearer in the SeNB addition request as the correlation ID, and set a transport layer address of the SCG bearer in the SeNB addition request as the IP address of the LGW. If the bearer to be established is a split bearer, the MeNB may allocate an uplink TEID and a transport layer address of an X2 interface to the split bearer.

[228] As such, user plane data on an SCG bearer is forwarded from the LGW at the MeNB to the SeNB, and user plane data on a split bearer is forwarded from the LGW at the MeNB to the MeNB (e.g., PDCP processing) and then to the SeNB.

[229] At block 809, the SeNB may send an SeNB addition request confirm message to the MeNB, and the SeNB may allocate resources.

[230] The SeNB addition request confirm message may include the local network identity of the SeNB.

[231] At block 810, an RB bearer of over air interface may be established for the UE.

[232] At block 811, the MeNB may send an initial context setup response or an E-RAB

setup response to the MME.

[233] At block 812, the MME may send a bearer modification request to the SGW.

[234] At block 813, the SGW may send a bearer modification request to the LGW.

[235] At block 814, the LGW may send a bearer modification response to the SGW.

[236] At block 815, the SGW may send a bearer modification response to the MME.

[237] The method as shown in FIG. 8 can set up a SIPTO bearer or a LIPA bearer for a UE, especially when the LGW is in the MeNB.

[238] Various examples also provide an apparatus corresponding to the method of FIG. 8. The apparatus is applicable for supporting local breakout in a dual-connectivity architecture. The apparatus may include: a first module, a second module, a third module and a fourth module.

[239] The first module is configured to receive a non-access stratum (NAS) message from a user equipment (UE);

[240] The second module is configured to send to a mobility management entity (MME) an initial UE message or an uplink direct transfer message which includes the NAS message received from the UE; including in the message an IP address of a collocated local gateway (LGW) of the MeNB if the MeNB has the collocated LGW or an IP address of a collocated LGW of a secondary eNodeB (SeNB) of the UE if the SeNB has the collocated LGW;

[241] The third module is configured to receive from the MME an initial context setup request or an E-UTRAN Radio Access Bearer (E-RAB) setup request message which includes a correlation ID corresponding to a local Internet protocol access (LIPA) bearer or a SIPTO bearer to be established; and

[242] The fourth module is configured to send an SeNB addition request to the SeNB.

[243] In an example, if the bearer to be established is a SCG bearer, the fourth module may set an uplink TEID of the SCG bearer in the SeNB addition request as the correlation ID, and set a transport layer address of the SCG bearer in the SeNB addition request as the IP address of the LGW; if the bearer to be established is a split bearer, the fourth module may allocate an uplink TEID and a transport layer address of an X2 interface to the split bearer.

[244] The foregoing are only preferred examples of the present disclosure and are not for use in limiting the protection scope thereof. All modifications, equivalent replacements or improvements in accordance with the spirit and principles of the present disclosure shall be included in the protection scope of the present disclosure.

Claims

[Claim 1] A method of de-activating a local Internet protocol access (LIPA) bearer, applicable for local breakout in a dual-connectivity architecture, the method comprising:
triggering, by a master eNodeB (MeNB), a LIPA bearer de-activation process when determining to change a secondary eNodeB (SeNB) of a user equipment (UE) or to hand the UE over from the MeNB to an eNB, and then triggering a process of changing the SeNB of the UE or a process of handing the UE over from the MeNB to the eNB.

[Claim 2] The method of claim 1, wherein triggering the LIPA bearer de-activation process comprises:
sending, by the MeNB, a request for releasing a LIPA bearer to the SeNB to trigger the LIPA bearer de-activation process.

[Claim 3] The method of claim 2, wherein the request for releasing the LIPA bearer may be an SeNB modification request or a defined message that includes a bearer identity of the LIPA bearer to be released.

[Claim 4] The method of claim 1, further comprising:
sending, by a master eNodeB (MeNB) to a target secondary eNodeB (SeNB), an SeNB addition request which comprises information excluding information of a LIPA bearer when the MeNB determines to change a SeNB of a user equipment (UE); and
receiving, by the MeNB, an SeNB addition request confirm message from the target SeNB, and sending an SeNB release request to the source SeNB of the UE.

[Claim 5] The method of claim 4, wherein the SeNB release request sent by the MeNB to the source SeNB of the UE comprises information of an E-UTRAN Radio Access Bearer (E-RAB) to be released which includes an E-RAB identity of the E-RAB to be released and information for data forwarding; if the E-RAB is a LIPA bearer, the SeNB release request comprises an indication indicative of the E-RAB to be released is the LIPA bearer.

[Claim 6] The method of claim 1, further comprising:
sending, by a master eNodeB (MeNB) to a target eNB, a handover request which comprises information excluding information of a LIPA bearer when the MeNB determines to hand a user equipment (UE) from the MeNB to the target eNB ; and
receiving, by the MeNB, an handover request confirm message from

the target eNB, and sending an SeNB release request to a source SeNB of the UE.

[Claim 7] The method of claim 6, wherein
the SeNB release request sent by the MeNB to the source SeNB of the UE comprises information of an E-UTRAN Radio Access Bearer (E-RAB) to be released which includes an E-RAB identity of the E-RAB to be released and information for data forwarding; when the E-RAB is a LIPA bearer, the SeNB release request comprises an indication indicative of the E-RAB to be released is the LIPA bearer.

[Claim 8] The method of claim 1, further comprising:
sending, by a master eNodeB (MeNB), an E-UTRAN Radio Access Bearer (E-RAB) modification request to a mobility management entity (MME) when the MeNB determines to switch a local breakout bearer, wherein the E-RAB modification request comprises a local network identity of a target eNB that the local breakout bearer to be switched to or information indicative of that the local offload bearer is switched out the source local home network, or the E-RAB modification request comprises an identity of the local breakout bearer and an identity of a target local home network to which the local breakout bearer is to be switched; and
receiving, by the MeNB, an E-RAB modification request confirm message from the MME.

[Claim 9] The method of claim 8, further comprising:
if the MeNB determines to switch the local breakout bearer from a first secondary eNodeB (SeNB) to a second SeNB,
sending, by the MeNB to the second SeNB, an SeNB addition request which includes a local breakout indication before sending the E-RAB modification request to the MME; and
receiving, by the MeNB from the second SeNB, an SeNB addition request confirm message, and obtaining a local network identity of the second SeNB from the SeNB addition request confirm message.

[Claim 10] The method of claim 1, further comprising:
obtaining, by a master eNodeB (MeNB), a local network identity of a target eNB when the MeNB determines to switch a local breakout bearer; and
sending, by the MeNB to a mobility management entity (MME), an E-RAB release request which includes an E-RAB identity of a SIPTO bearer to be released if the target eNB is in a local home network

different from a local home network of a source eNB.

[Claim 11] The method of claim 10, wherein obtaining by the MeNB the local home network identity of the target eNB comprises at least one of:
sending, by the MeNB to a target secondary eNodeB (SeNB), an SeNB addition request which includes a local breakout indication; receiving, by the MeNB, an SeNB addition request confirm message from the target SeNB and obtaining a local home network identity of the target SeNB from the SeNB addition request confirm message;
obtaining, by the MeNB, the local home network identity of the target eNB from an X2 setup process, wherein an X2 setup request sent during the X2 setup process includes a local home network identity of an eNB that sent the X2 setup request, and an X2 setup response sent during the X2 setup process includes a local home network identity of an eNB that sent the X2 setup response; and
obtaining, by the MeNB, the local home network identity of the target eNB through automatic neighbour relation (ANR).

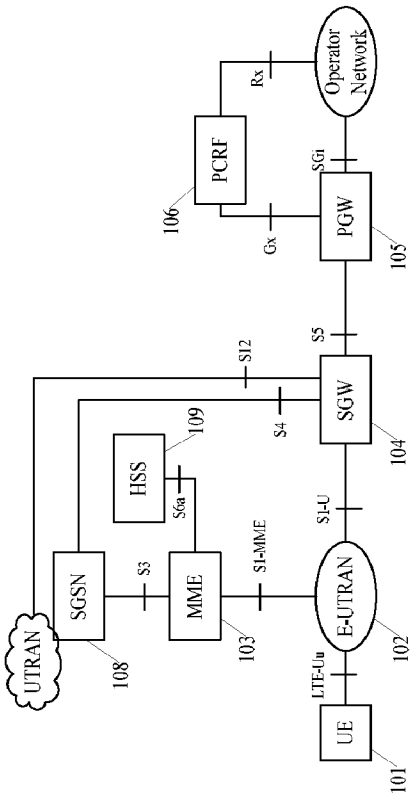
[Claim 12] The method of claim 1, further comprising:
receiving, by a master eNodeB (MeNB), a non-access stratum (NAS) message from a user equipment (UE);
sending, by the MeNB to a mobility management entity (MME), an initial UE message or an uplink direct transfer message which includes the NAS message received from the UE; including, by the MeNB, an IP address of a collocated local gateway (LGW) of the MeNB if the MeNB has the collocated LGW or an IP address of a collocated LGW of a secondary eNodeB (SeNB) of the UE if the SeNB has the collocated LGW;
receiving, by the MeNB from the MME, an initial context setup request or an E-RAB setup request message which includes a correlation ID corresponding to a LIPA bearer to be established; and
sending, by the MeNB, an SeNB addition request to the SeNB.

[Claim 13] The method of claim 12, further comprising:
if the bearer to be established is a secondary cell group (SCG) bearer, setting, by the MeNB, an uplink tunnel end identity (TEID) of the SCG bearer in the SeNB addition request as the correlation ID, and setting a transport layer address of the SCG bearer in the SeNB addition request as the IP address of the LGW; if the bearer to be established is a split bearer, allocating, by the MeNB, an uplink TEID and a transport layer address of an X2 interface to the split bearer.

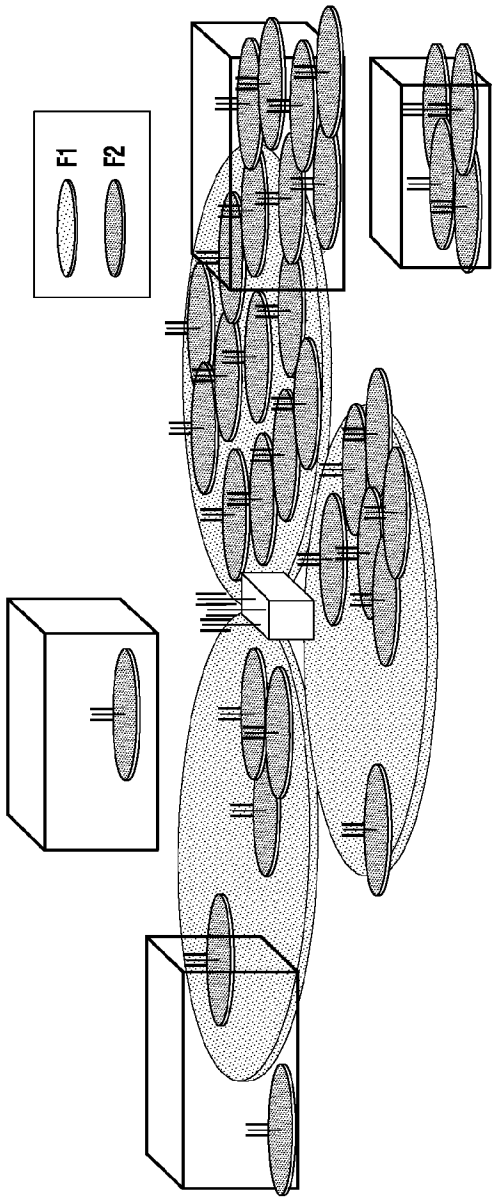
[Claim 14] A method of de-activating a local Internet protocol access (LIPA) bearer, applicable for local breakout in a dual-connectivity architecture, the method comprising:
receiving, by a secondary eNodeB (SeNB), a request for releasing a LIPA bearer from a master eNodeB (MeNB); and
activating a LIPA bearer de-activation process in a local gateway (LGW) through internal signaling.

[Claim 15] An apparatus for de-activating a local Internet protocol access (LIPA) bearer, applicable for local breakout in a dual-connectivity architecture configured to one of claims 1 to 13.

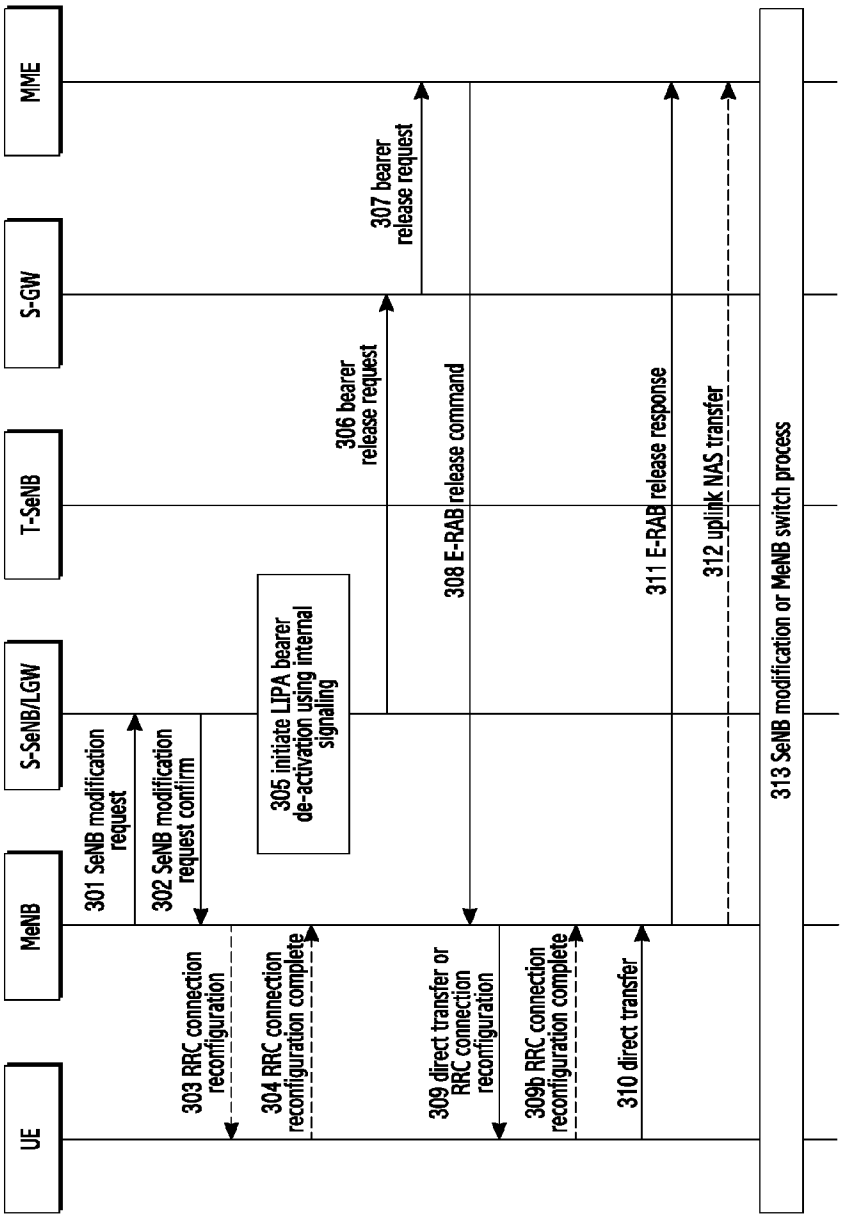
[Fig. 1]


Operator Network
Rx
PCRF
106
SGi
PGW
105
Gx
S5
S12
SGW
104
S4
109
HSS
S6a
S1-U
S1-MME
S3
SGSN
MME
E-UTRAN
102
103
LTE-Uu
UTRAN
108
UE
101

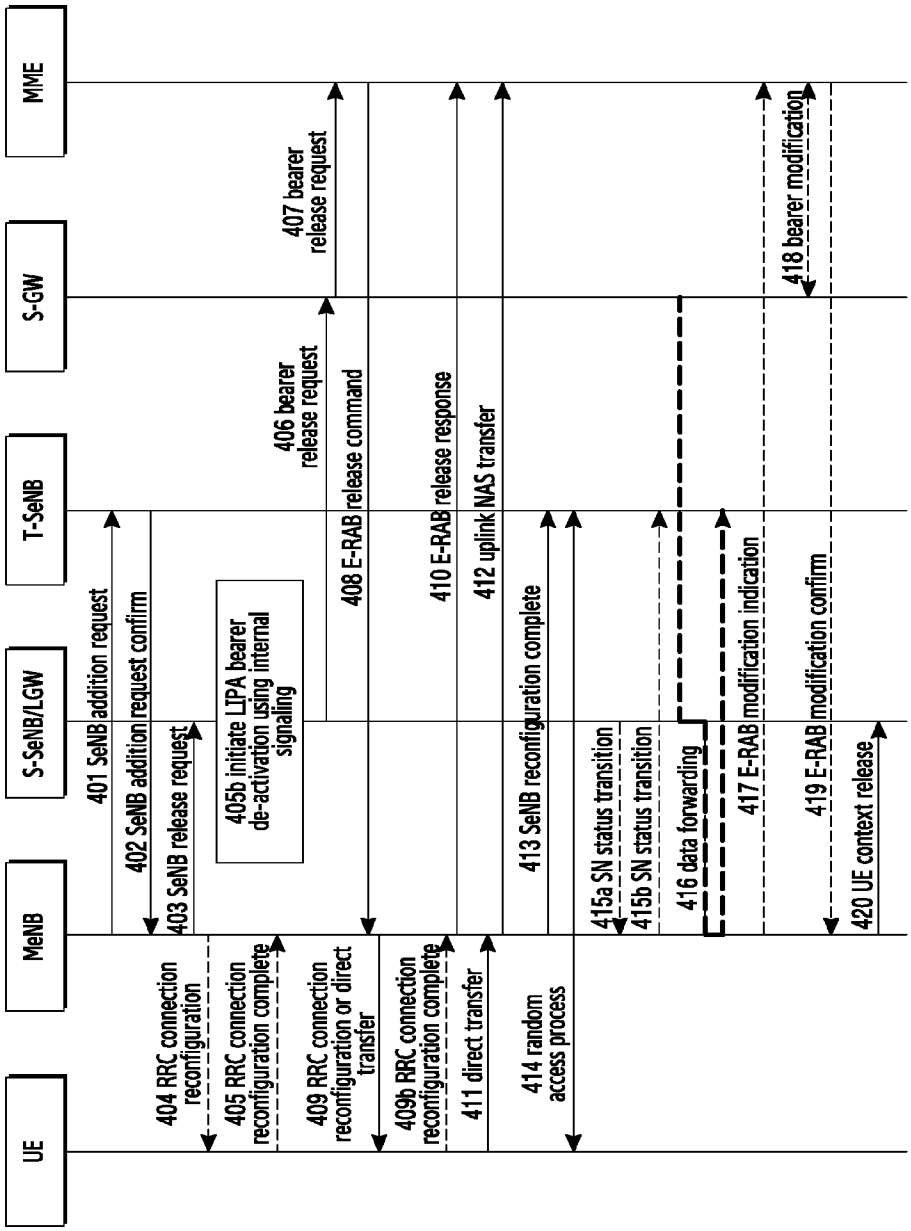
[Fig. 2]



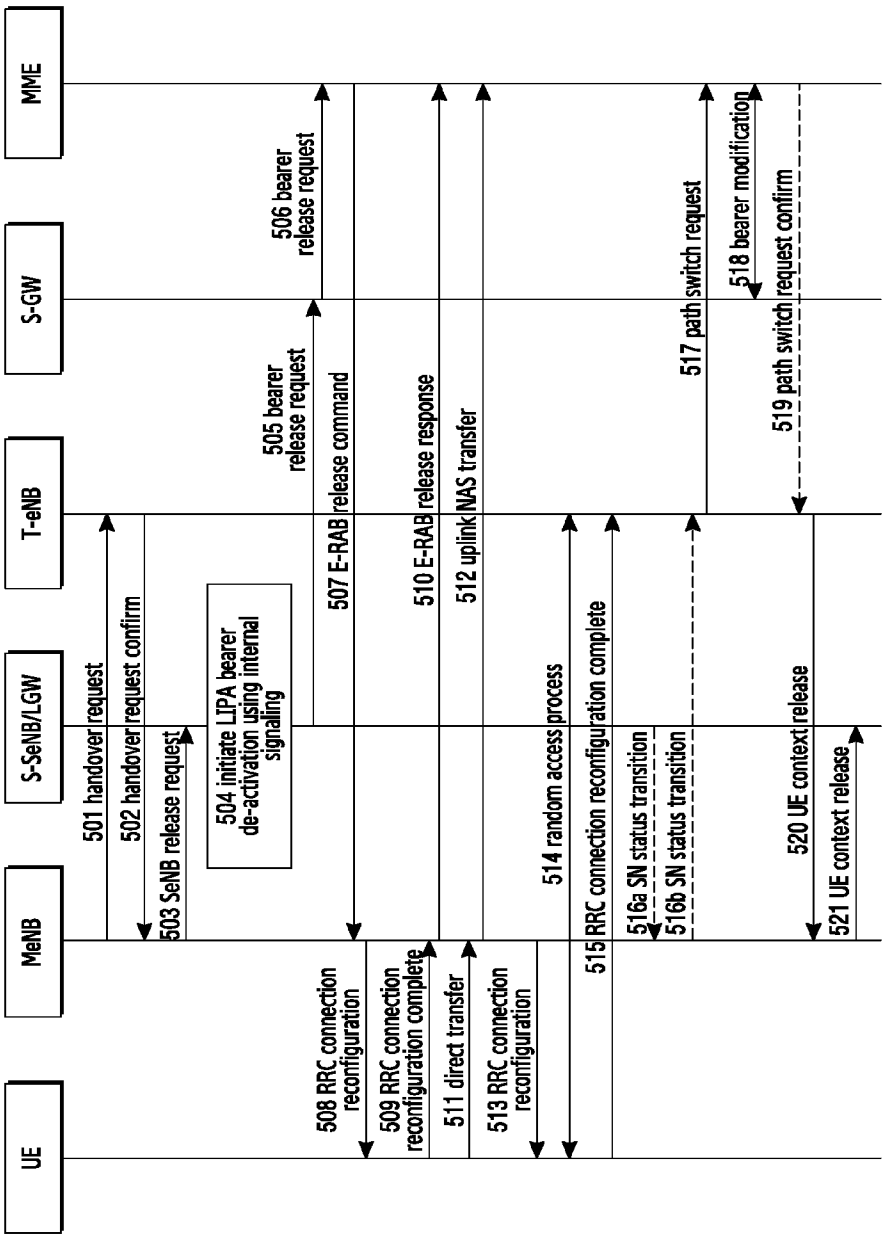
[Fig. 3]


UE
MeNB
S-SeNB/LGW
T-SeNB
S-GW
MME
301 SeNB modification request
302 SeNB modification request confirm
303 RRC connection reconfiguration
304 RRC connection reconfiguration complete
305 initiate LIPA bearer de-activation using internal signaling
306 bearer release request
307 bearer release request
308 E-RAB release command
309 direct transfer or RRC connection reconfiguration
309b RRC connection reconfiguration complete
310 direct transfer
311 E-RAB release response
312 uplink NAS transfer
313 SeNB modification or MeNB switch process

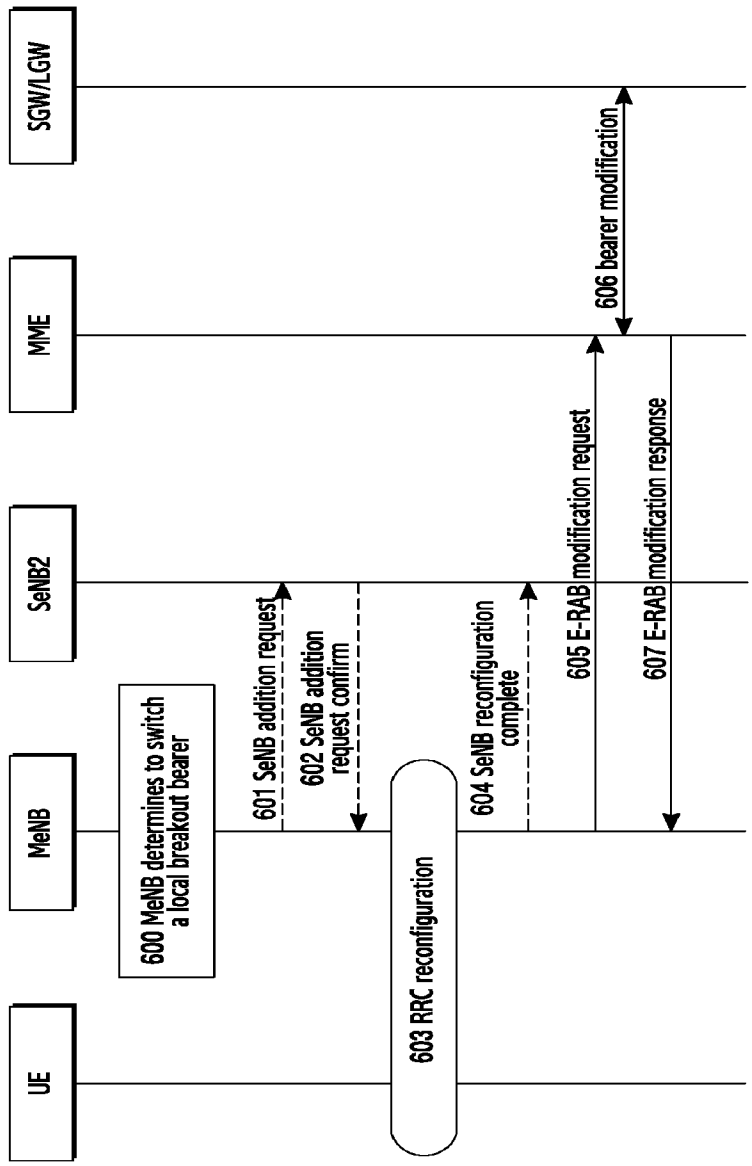
[Fig. 4]


UE
MeNB
S-SeNB/LGW
T-SeNB
S-GW
MME
401 SeNB addition request
402 SeNB addition request confirm
403 SeNB release request
405b initiate LIPA bearer de-activation using internal signaling
406 bearer release request
407 bearer release request
408 E-RAB release command
410 E-RAB release response
412 uplink NAS transfer
413 SeNB reconfiguration complete
415a SN status transition
415b SN status transition
416 data forwarding
417 E-RAB modification indication
418 bearer modification
419 E-RAB modification confirm
420 UE context release
404 RRC connection reconfiguration
405 RRC connection reconfiguration complete
409 RRC connection reconfiguration or direct transfer
409b RRC connection reconfiguration complete
411 direct transfer
414 random access process

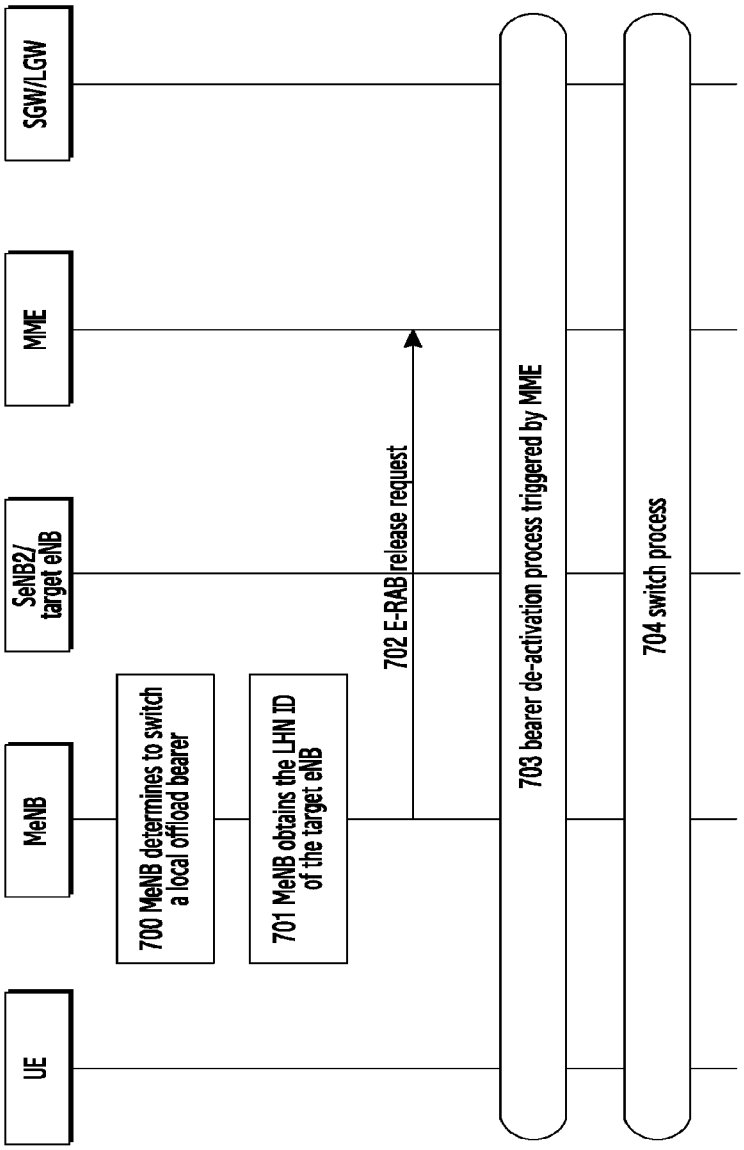
[Fig. 5]


UE
MeNB
S-SeNB/LGW
T-eNB
S-GW
MME
501 handover request
502 handover request confirm
503 SeNB release request
504 initiate LIPA bearer de-activation using internal signaling
505 bearer release request
506 bearer release request
507 E-RAB release command
508 RRC connection reconfiguration
509 RRC connection reconfiguration complete
510 E-RAB release response
511 direct transfer
512 uplink NAS transfer
513 RRC connection reconfiguration
514 random access process
515 RRC connection reconfiguration complete
516a SN status transition
516b SN status transition
517 path switch request
518 bearer modification
519 path switch request confirm
520 UE context release
521 UE context release

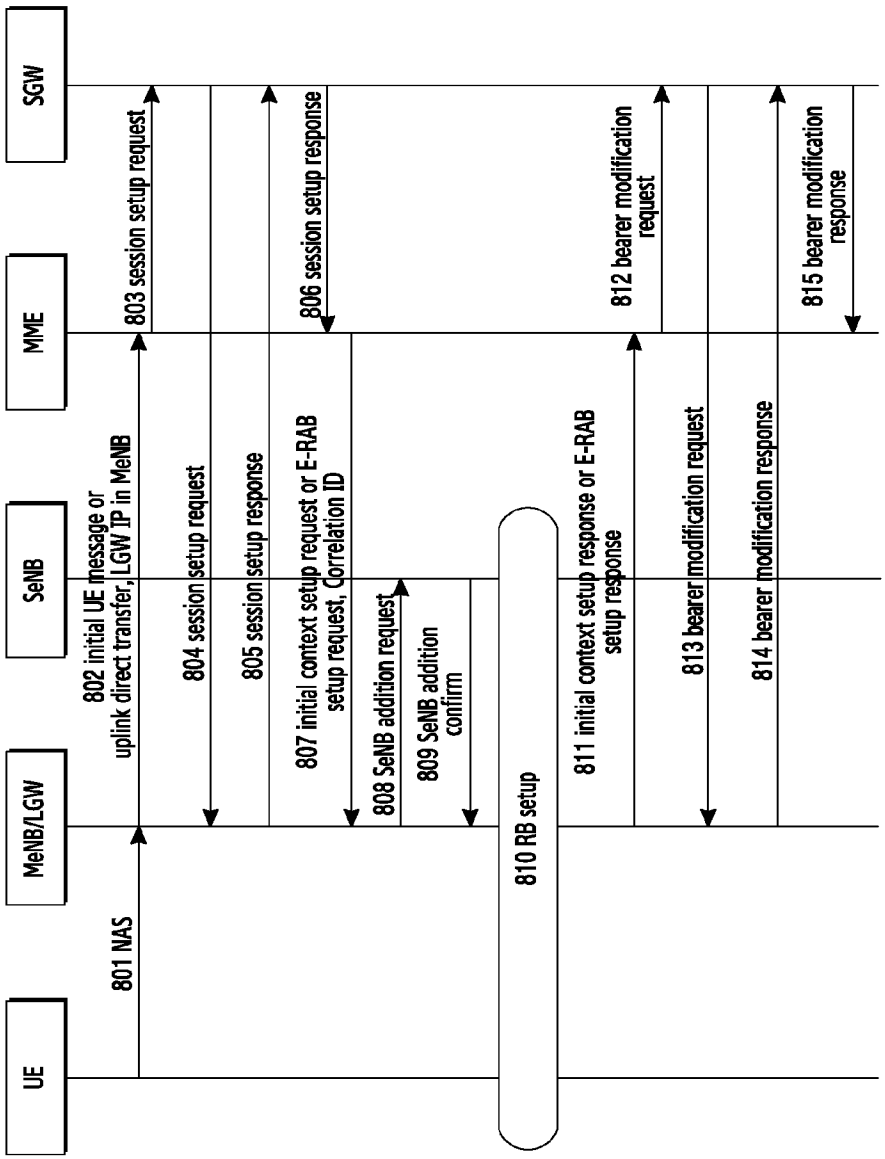
[Fig. 6]


SGW/LGW
MME
SeNB2
MeNB
UE
600 MeNB determines to switch a local breakout bearer
601 SeNB addition request
602 SeNB addition request confirm
603 RRC reconfiguration
604 SeNB reconfiguration complete
605 E-RAB modification request
606 bearer modification
607 E-RAB modification response

[Fig. 7]


SGW/LGW
MME
SeNB2/ target eNB
MeNB
UE
700 MeNB determines to switch a local offload bearer
701 MeNB obtains the LHN ID of the target eNB
702 E-RAB release request
703 bearer de-activation process triggered by MME
704 switch process

[Fig. 8]


UE
MeNB/LGW
SeNB
MME
SGW
801 NAS
802 initial UE message or uplink direct transfer, LGW IP in MeNB
803 session setup request
804 session setup request
805 session setup response
806 session setup response
807 initial context setup request or E-RAB setup request, Correlation ID
808 SeNB addition request
809 SeNB addition confirm
810 RB setup
811 initial context setup response or E-RAB setup response
812 bearer modification request
813 bearer modification request
814 bearer modification response
815 bearer modification response

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2016/000769

A. CLASSIFICATION OF SUBJECT MATTER

H04W 36/00(2009.01)i, H04W 36/08(2009.01)i, H04W 76/02(2009.01)i, H04W 76/06(2009.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04W 36/00; H04W 4/22; H04W 36/14; H04W 48/08; H04W 76/06; H04W 8/02; H04W 36/08; H04W 76/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & keywords: local internet protocol access, LIPA, deactivating, local breakout

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 8937924 B2 (NOUN CHOI et al.) 20 January 2015 See column 16, line 40-column 17, line 14; claims 1, 7; and figure 11.	1,14-15
A		2-13
A	US 2013-0308527 A1 (CHEN HO CHIN et al.) 21 November 2013 See paragraphs [0129]-[0137]; and figure 11.	1-15
A	US 2013-0003698 A1 (ULISES OLVERA-HERNANDEZ et al.) 03 January 2013 See paragraphs [0082]-[0087]; and figure 15.	1-15
A	WO 2012-157959 A2 (SAMSUNG ELECTRONICS CO., LTD.) 22 November 2012 See paragraphs [25]-[35]; and figure 4.	1-15
A	WO 2012-093886 A2 (LG ELECTRONICS INC.) 12 July 2012 See paragraphs [0081]-[0099]; and figure 8.	1-15

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 May 2016 (24.05.2016)	**24 May 2016 (24.05.2016)**

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR2016/000769

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		WO 2012-157959 A3	24/01/2013
WO 2012-093886 A2	12/07/2012	US 2013-0272268 A1	17/10/2013
		US 9125213 B2	01/09/2015
		WO 2012-093886 A3	06/12/2012
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		WO 2012-093886 A9	04/04/2013